[0027]

## CLAIMS

1. A power transfer assembly comprising:

a power turbine constructed of a nickel alloy;

a gear shaft constructed of a low-carbon carburized gear material; and

a transition portion between and welded to each of the power turbine and gear shaft.

2. The assembly of claim 1, wherein the power turbine is constructed of AMS 5377 Inconel 713 LC; wherein the gear shaft is constructed of 9310 steel; and wherein the transition portion is constructed of 4140 steel.

3. The assembly of claim 2, wherein the gear shaft is carburized and includes an integral pinion gear that meets the AGMA Q12 standard.

4. The assembly of claim 1, wherein the transition portion is inertia welded to the power turbine and is electron beam welded to the gear shaft.

5. The assembly of claim 4, wherein the inertia weld meets the MIL-STD-1252 standard and the electron beam weld meets the AMS 2681 standard.

6. The assembly of claim 1, wherein the power turbine and gear shaft each have axes of symmetry that are collinear with each other, and wherein the power transfer assembly rotates about an axis of rotation that is substantially collinear with the axes of symmetry.

7. The assembly of claim 1, wherein the power turbine is a radial flow turbine.

8. The assembly of claim 6, wherein the gear shaft has a pinion gear integrally formed therein.

9. The assembly of claim 7, wherein the gear shaft includes at least one bearing surface.

10. A microturbine engine comprising:

a recuperator having a hot gas flow path and a cool gas flow path;

a compressor providing a flow of compressed gas to the cool gas flow path of the recuperator, the compressed gas being heated within the recuperator;

a source of fuel providing a flow of fuel;

a combustor receiving the heated flow of compressed gas from the recuperator and the flow of fuel from the source of fuel, and combusting a mixture of compressed gas and fuel to produce a flow of hot gas;

a radial flow turbine receiving the flow of hot gas from the combustor and discharging a flow of exhaust gas;

a power transfer assembly including a turbine wheel constructed of a nickel alloy, a gear shaft constructed of a low-carbon carburized gear material and having a pinion gear integrally formed therein, and a transition portion between and welded to each of the turbine wheel and gear shaft, the turbine wheel being within the radial flow turbine and rotating in response to the flow of hot gas through the turbine;

a bull gear in meshing engagement with the pinion gear; and

an electric generator generating electricity in response to rotation of the bull gear.

11. The engine of claim 10, wherein the power turbine is constructed of AMS 5377 Inconel 713 LC; wherein the gear shaft is constructed of 9310 steel; and wherein the transition portion is constructed of 4140 steel.

12. The engine of claim 11, wherein the gear shaft is carburized and includes an integral pinion gear that meets the AGMA Q12 standard.

13. The engine of claim 10, wherein the transition portion is inertia welded to the power turbine and is electron beam welded to the gear shaft.

14. The engine of claim 13, wherein the inertia weld meets the MIL-STD-1252 standard and the electron beam weld meets the AMS 2681 standard.

15. The engine of claim 10, wherein the power turbine and gear shaft each have axes of symmetry that are collinear with each other, and wherein the power transfer assembly rotates about an axis of rotation that is substantially collinear with the axes of symmetry.

16. The engine of claim 10, wherein the gear shaft includes first and second bearing surfaces, the engine further comprising first and second bearings supporting the gear shaft at the first and second bearing surfaces for rotation at about 44,300 rpm.

17. A method for manufacturing a power transfer assembly, the method comprising:
constructing a turbine wheel of a nickel alloy;
constructing a transition portion of a high-carbon steel;
constructing a gear shaft of a low-carbon carburized gear steel;
inertia welding the stub shaft to the turbine wheel; and
electron beam welding the gear shaft to the transition portion.

18. The method of claim 17, wherein the constructing a turbine wheel step includes constructing the turbine wheel of AMS 5377 Inconel 713 LC; wherein the constructing a transition portion step includes constructing the transition portion of 4140 steel; and wherein the constructing a gear shaft step includes constructing the gear shaft of 9310 steel.

19. The method of claim 17, wherein the steps of constructing a transition portion and inertia welding include constructing a stub shaft of high-carbon steel, inertia welding the stub shaft to the turbine wheel, and machining the stub shaft into the desired dimensions for the transition portion.

20. The method of claim 19, wherein the step of inertia welding includes meeting the MIL-STD-1252 standard in the inertia weld.

21. The method of claim 19, wherein the constructing a gear shaft step includes providing a projection integral with the gear shaft; wherein the machining step includes machining into the transition portion a recess dimensioned to snugly receive the projection; and wherein the electron beam welding step includes first inserting the projection into the recess and then electron beam welding the interface between the transition portion and the gear shaft.

22. The method of claim 17, wherein the electron beam welding step includes meeting the AMS 2681 standard in the electron beam weld.

23. The method of claim 17, wherein the power turbine and gear shaft each have axes of symmetry, and wherein the inertia welding and electron beam welding steps include aligning the axes of symmetry such that they are collinear with each other.